Fatigue fracture assessment of high strength steel using thermographic analysis

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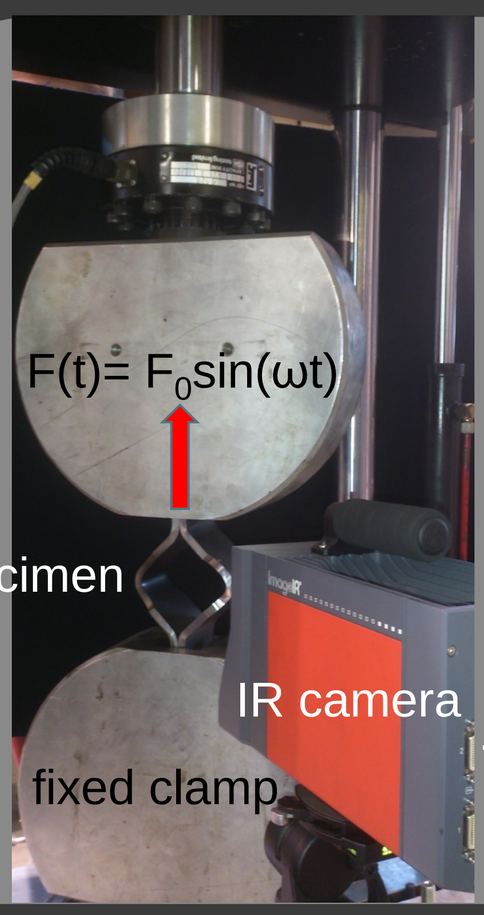
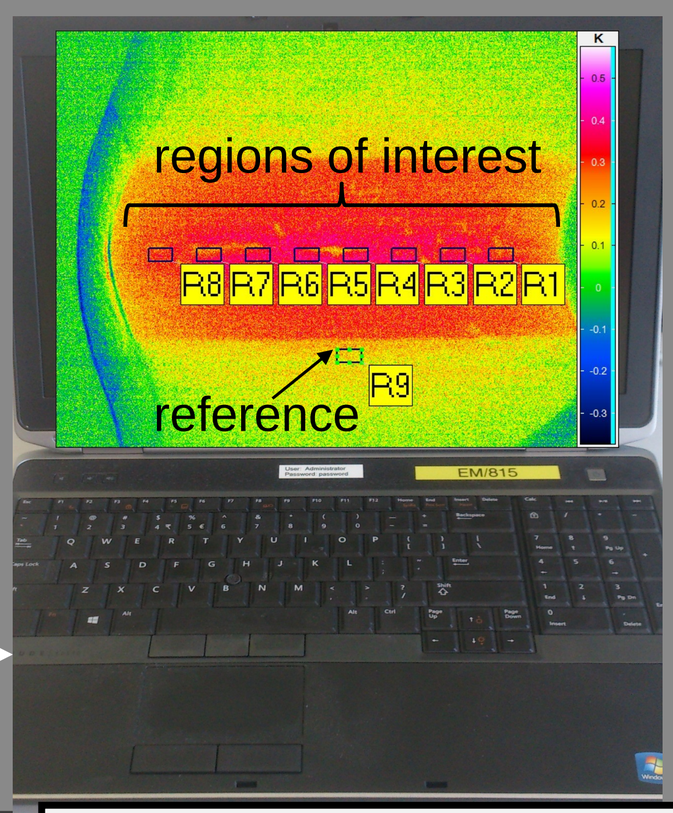
Experimental set-up and background





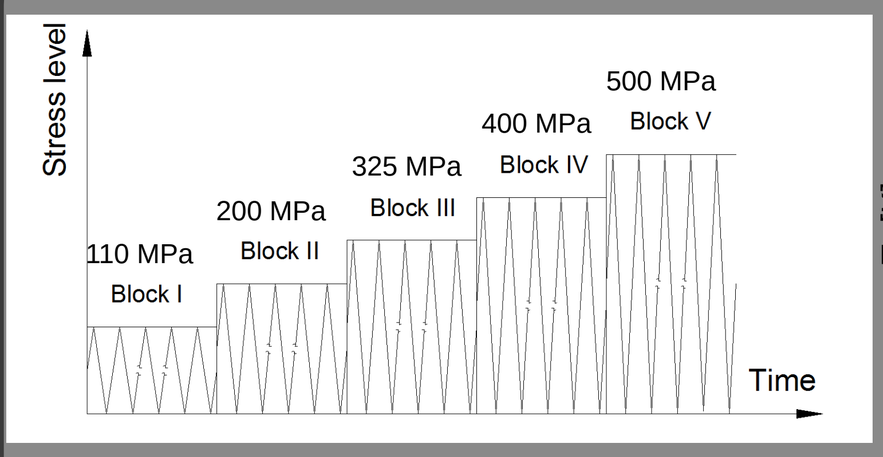
$$T_{exp}(t) = LD(t) + T_1 \sin(\omega t + \varphi_1) + T_2 \sin(2\omega t + \varphi_2)$$

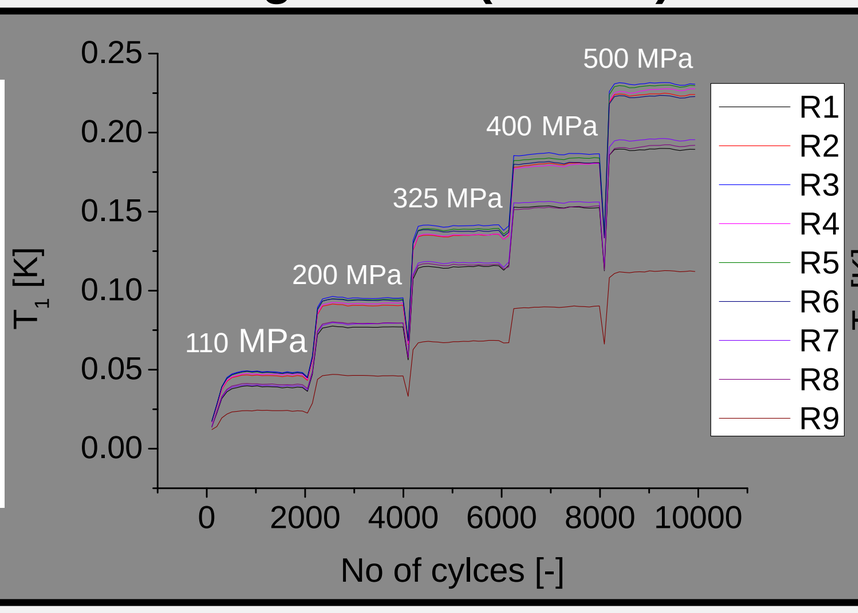
LD(t): linear drift, T_1: thermoelastic effect, T_2: plasticity, ω is angular frequency of fatigue load, φ_s: phase shifts, t: time

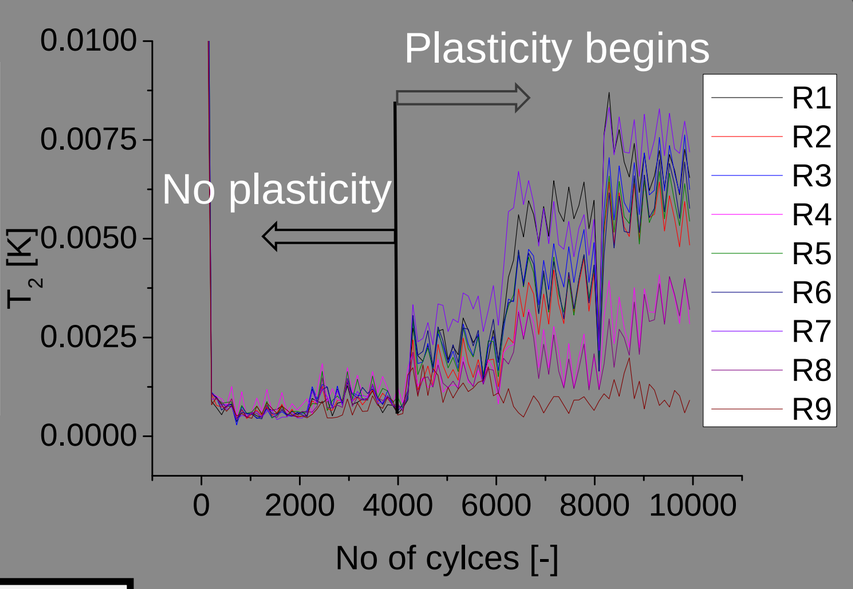
$$T_1 = -\frac{\alpha T_0}{\rho C_p}\sigma_{kk} = -k\sigma_{kk}$$

α: coef. of thermal expansion, C_p: heat capacity at constant pressure, ρ: mass density, σ_{kk}: sum of principal stresses, k: thermoelastic constant, T_0: initial temperature

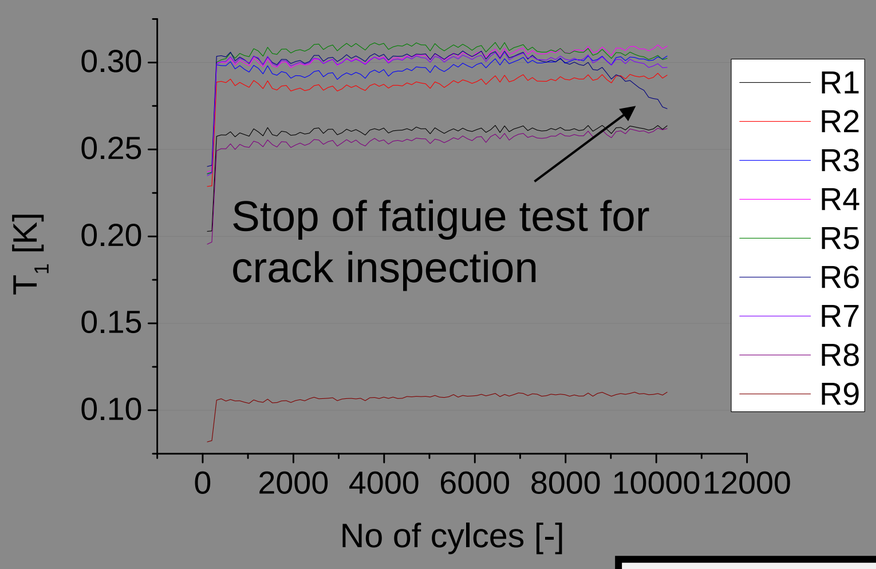
Fatigue limit (off-line)

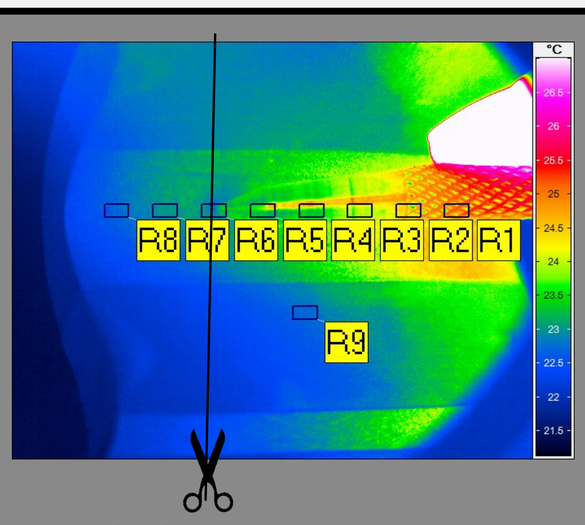






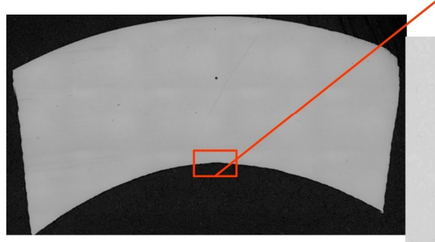
On-line detection of crack initiation

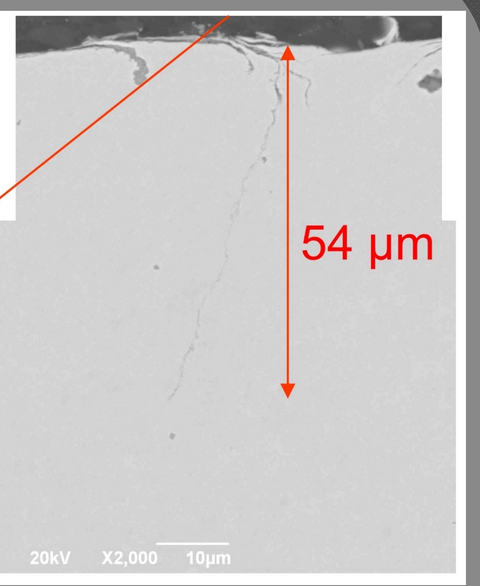




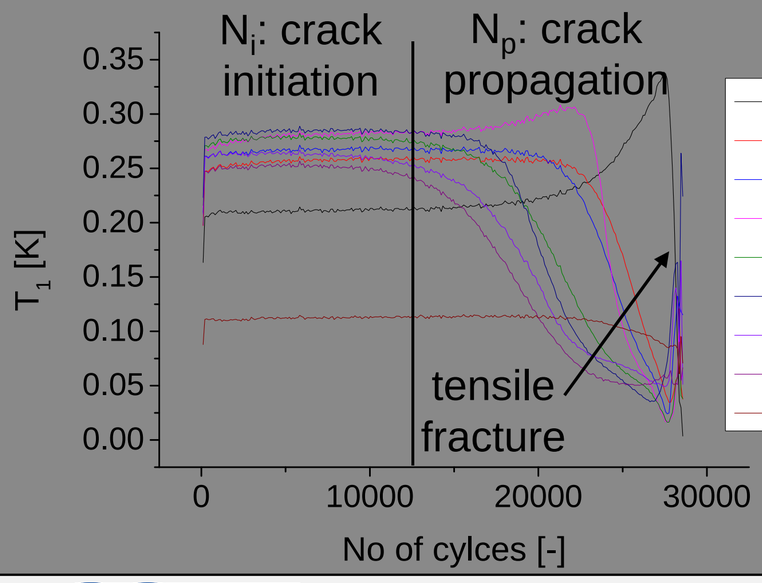
Sectional plane for crack inspection

Optical microscopy for crack

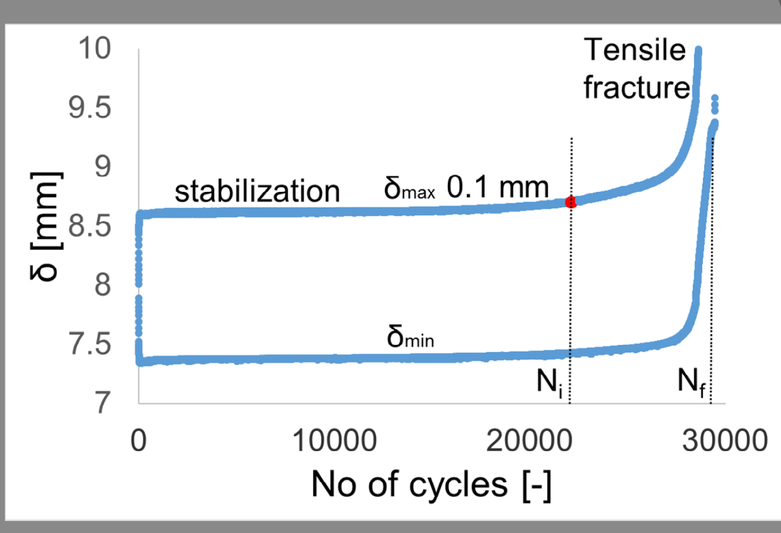




Proportion of crack initiation time (N_i) to total lifetime (N_f)



	Thermography	Cross-head displacement
Crack length	~54 µm	~600 µm
N_i/N_f	~50%	~80%



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